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MACTEC ENVIRONMENTAL RESTORATION SERVICES, LLC

Spectral Gamma-Ray Borehole
Log Data Report

Log Event A

Borehole # 50-06-04

Borehole Information

Farm : T	**Tank :** T-106	**Site Number :** 299-W10-110
N-Coord : 43,531	**W-Coord :** 75,780	**TOC Elevation :** 671.30
Water Level, ft :	**Date Drilled :** 7/31/1973	

Casing Record

Type : Steel-welded	Thickness, in. : 0.280	ID, in. : 6
Top Depth, ft. : 0	Bottom Depth, ft. : 93	

Borehole Notes:

Borehole 50-06-04 was drilled in July 1973 to a depth of 93 ft with 6-in. casing. Data from the drilling log and Chamness and Merz (1993) were used to provide borehole construction information. Although no information concerning grouting or perforations is provided, it is assumed that the borehole was not grouted or perforated since this was not a routine practice during the early 1970s drilling campaign. The casing thickness is presumed to be 0.28 in., on the basis of the published thickness for schedule-40, 6-in. steel tubing.

Equipment Information

Logging System : 2B	**Detector Type :** HPGe	**Detector Efficiency:** 35.0 %
Calibration Date : 11/1997	**Calibration Reference :** GJO-HAN-20	**Logging Procedure :** MAC-VZCP 1.7.10-1

Logging Information

Log Run Number :	1	**Log Run Date :**	03/02/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	0.0	**Counting Time, sec.:**	200	**L/R :** L	**Shield :** N
Finish Depth, ft. :	25.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	2	**Log Run Date :**	03/03/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	24.0	**Counting Time, sec.:**	200	**L/R :** L	**Shield :** N
Finish Depth, ft. :	33.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Log Run Number :	3	**Log Run Date :**	03/03/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	32.0	**Counting Time, sec.:**	200	**L/R :** R	**Shield :** N
Finish Depth, ft. :	53.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

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Log Run Number :	4	**Log Run Date :**	03/03/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	52.0	**Counting Time, sec.:**	200	**L/R :** L	**Shield :** N
Finish Depth, ft. :	72.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	5	**Log Run Date :**	03/04/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	92.5	**Counting Time, sec.:**	200	**L/R :** L	**Shield :** N
Finish Depth, ft. :	71.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a
Log Run Number :	6	**Log Run Date :**	03/04/1998	**Logging Engineer:**	Alan Pearson
Start Depth, ft.:	70.0	**Counting Time, sec.:**	200	**L/R :** L	**Shield :** N
Finish Depth, ft. :	50.0	**MSA Interval, ft. :**	0.5	**Log Speed, ft/min.:**	n/a

Logging Operation Notes:

This borehole was logged by the SGLS in six log runs using a 200-s counting time. Five of the log runs were required to log the length of the borehole. An additional log run was performed to repeat an interval of the borehole as a quality check. The top of the borehole casing, which is the zero reference for the SGLS, is approximately flush with the ground surface. The total logging depth achieved was 92.5 ft.

High dead time (greater than 40 percent) was encountered during log run two at a depth of 33 ft. As a result, log run three was logged in real time from 32 to 53 ft. Log runs four, five, and six (52 to 92.5 ft) were logged in live time after the dead time dropped below 40 percent.

Analysis Information

Analyst : E. Larsen

Data Processing Reference : MAC-VZCP 1.7.9 Analysis Date : 07/06/1998

Analysis Notes :

The pre-survey and post-survey field verification for each logging run met the acceptance criteria established for peak shape and system efficiency. The energy calibration and peak-shape calibration from the accepted calibration spectrum that most closely matched the field data were used to establish the peak resolution and channel-to-energy parameters used in processing the spectra acquired during the logging operation.

A casing correction factor for a 0.280-in.-thick steel casing was applied to the concentration data during the analysis process.

Shape factor analysis was applied to the SGLS data and provides insights into the distribution of Cs-137 contamination and into the nature of zones of elevated total count gamma-ray activity not attributable to gamma-emitting radionuclides.

Log Plot Notes:

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Separate log plots show the man-made and the naturally occurring radionuclides. The natural radionuclides can be used for lithology interpretations. The headings of the plots identify the specific gamma rays used to calculate the concentrations. Uncertainty bars on the plots show the estimated uncertainties for the measurements as 95-percent confidence intervals. Open circles on the plots give the MDL. The MDL of a radionuclide represents the lowest concentration at which positive identification of a gamma-ray peak is statistically defensible.

A combination plot includes the man-made and natural radionuclides, the total gamma derived from the spectral data, and the Tank Farms gross gamma log. The gross gamma plot displays the latest available digital data. No attempt has been made to adjust the depths of the gross gamma logs to coincide with the SGLS data.

The interval between 55 and 70 ft was relogged as a quality assurance measure to establish the repeatability of the radionuclide concentration measurements made by the SGLS at that time. The radionuclide concentrations were calculated using separate data sets provided by the original and rerun logging runs. A comparison of the two data sets are shown on individual log plots.

A plot of the shape factor analysis results is also included. The plot is used as an interpretive tool to help determine the radial distribution of man-made contaminants around the borehole.

A time-sequence plot of the historical gross gamma log data from 1975 to 1994 is presented with the SGLS log plots. A plot that compares the decay rate of the historical gross gamma data with the calculated decay curves for specific radionuclides is also included.

Results/Interpretations:

Detector saturation or very high dead time (greater than 99 percent) occurred from 34.5 to 40.5 ft. As a result, no usable spectral data were collected along this region of the borehole. A zone of high dead time (60 to 85 percent) occurred from 41 to 49 ft. Although the accuracy of the radioassays collected within this interval may be limited, the available spectral data are still included on the log plot.

The man-made radionuclides Cs-137, Co-60, Eu-154, Eu-152, and Sn-126 were detected by the SGLS. The Cs-137 contamination was detected continuously from the ground surface to 34 ft and from 41 to 42.5 ft. The Co-60 contamination was measured continuously from 41.5 ft to the bottom of the logged interval (92.5 ft). The Eu-154 contamination was detected continuously from 41 ft to the bottom of the logged interval. A small zone of Eu-154 contamination was detected directly above the zone of detector saturation from 33 to 33.5 ft. The Eu-152 contamination was measured from 42 to 42.5 ft, nearly continuously from 45.5 to 65.5 ft, and from 79 ft to the bottom of the logged interval. A few isolated occurrences of Eu-152 contamination were detected between 67.5 and 72.5 ft. Sn-126 contamination was detected at 55.5 ft and from 58 to 58.5 ft.

Almost all of the K-40 and Th-232 concentration values are absent from 34 to 49 ft. Most of the U-238 concentrations are absent from 34 to 61 ft.

Increased U-238 and Th-232 concentrations were detected from 80.5 to 90 ft. The KUT concentrations decrease sharply from about 90 ft to the bottom of the logged interval.

Additional information and interpretations of log data are included in the main body of the Tank Summary Data Report for tank T-106.